

NATIONAL SCIENCE STANDARD

- Personal and Social Perspectives: Types of Resources
- Life Science: The Characteristics of Organisms

OBJECTIVES

The student will:

1. be able to identify the source of fossil fuels and biofuels.
2. be able to explain why fossil fuels are non-renewable.
3. be able to explain why plant sources of fuels are renewable.
4. understand the relation of natural resources in respect to use for fuel and food using a Venn diagram.

BACKGROUND

Fossil fuels were formed from vegetation and animal life, including dinosaurs, deposited 380 to 245 million years ago.

As the plant and animal life died, they were buried under mud which gradually hardened as rock. The rotting plants and decayed animal were compressed between heavy layers of the rock and heated by the earth. Over million of years they changed into coal, oil, and natural gas deposits.

Although this process continues right now, we are using these fuels at several million times faster than they are being formed. Because they eventually can be completely used up they are considered nonrenewable.



“Bio” refers to living things. Fuels made from plants are called biofuels.

Corn, a very common crop in the Midwest, can be made into fuel. The corn is fermented and made into a liquid fuel. We can continuously plant and grow more corn; therefore, it is a renewable source of energy. Soybeans can also be made into fuel.

In the near future agricultural waste such as stalks, leaves and husks of corn will be able to be used, too. Long term plans include growing crops just for fuel such as fast-growing trees and grasses that can grow on land that will not support food crops.

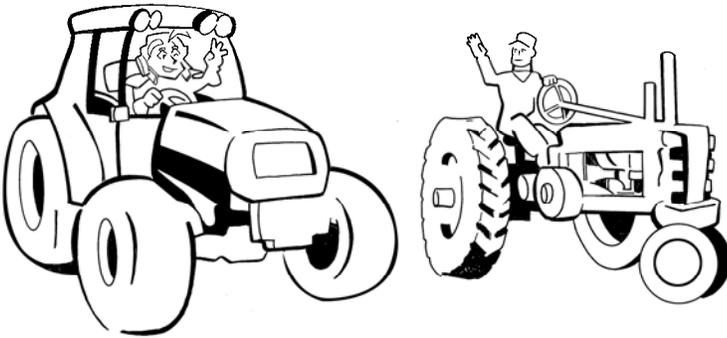
FAST FACTS

Fuel made from corn is ethanol.

Fuel made from soybeans is biodiesel.

INSTRUCTIONAL PROCEDURE

1. Discuss the difference between fossil fuels and biofuels.
2. Complete Activity 1 “Renewing Fuel.”
3. Complete Activity 2 “Food or Fuel?”



ASSESSMENT

Have the student explain how it helps the earth to use renewable sources of energy. What affect will using renewable sources of energy have on you? On your children? On your grandchildren?

WORD POWER

biofuel *n.* Fuel such as wood or ethanol, derived from biomass.

biomass *n.* Organic matter, esp. plant matter, that can be converted to fuel and is therefore regarded as a potential energy source.

ethanol *n.* Alcohol made from plant sources and used for fuel.

renewable fuel *n.* Fuel from sources that can never be used up.

nonrenewable fuel *n.* Fuel from sources limited in supply and can be used up.

fossil *n.* The remains or traces of an animal or a plant from millions of years ago, preserved as rock.

fossil fuel *n.* Coal, oil, or natural gas, formed from the remains of prehistoric plants and animals.

NAME _____

ACTIVITY 1 — RENEWING FUEL

COMPARE AND CONTRAST

Preparation:

- Get 3 containers.
- Cut out the same number of fossils (from next page) as you have students.
- Cut out 50% more of the corn (from next page) as you have students. (Ex: 25 students, cut out 37 corns)
- Label container the containers as follows:
 - Container A: Oil Deposits
 - Container B: 1st Corn Planting
 - Container C: 2nd Corn Planting
- Place the fossils in Container A and the corn in Container B. Leave Container C empty.



STEP 1: NONRENEWABLE FUELS DEMONSTRATION

1. Call on students at random to pull 1, 2, or 3 fossils from container A.
2. Ask the students about the outcome. Was everyone able to get fuel?

STEP 2: RENEWABLE FUELS DEMONSTRATION

1. Call students at to pull corn from container B. Ask them to pick 2 and replant 1 in container C.
2. When container B is empty, have the student pick 2 from container C and replant one in Container B.
3. Discuss what happened. Will the corn ever run out?

NAME _____

ACTIVITY 1 — RENEWING FUEL, CONTINUED

CUTOUTS



NAME _____

ACTIVITY 2 — FOOD OR FUEL?

VENN DIAGRAMS

Draw a Venn diagram showing the relation of the natural resources in the Resources List.

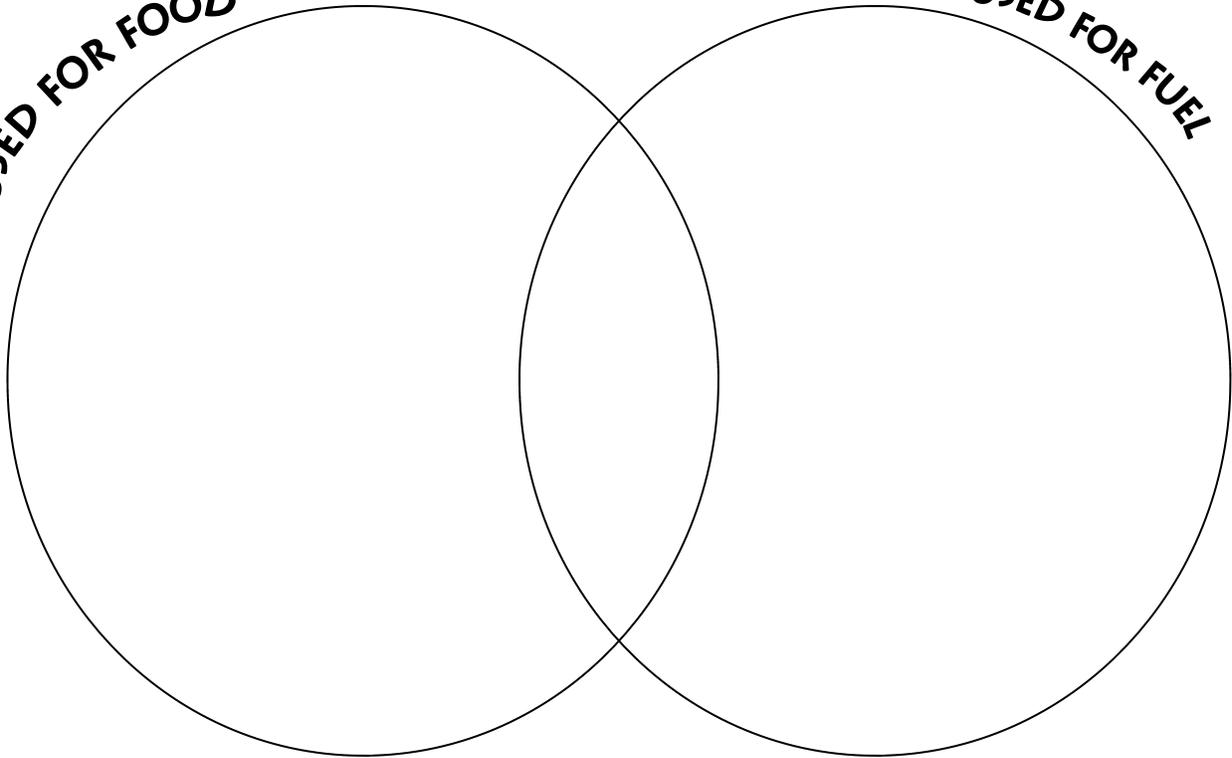
RESOURCES LIST

- CORN
- SOYBEAN
- TREES
- GRASS
- SOIL
- WATER
- AIR
- PETROLEUM OIL
- COAL
- PLANT WASTE PRODUCTS
- PEANUTS
- VEGETABLE
- FRUIT

NATURAL RESOURCES

USED FOR FOOD

USED FOR FUEL





GRADE 4 & 5 — A PLACE AND TIME

NATIONAL SCIENCE STANDARD

Geography: Understand how to apply geography to interpret the present and plan for the future.

OBJECTIVES

The student will:

1. locate on a map the countries that are the U.S.'s major suppliers of fossil fuels.
2. locate on a map the area of the U.S. that is the largest supplier of corn.
3. learn the events over the past 100 years that affected ethanol use.
4. consider the future of ethanol over the next 50 years.

BACKGROUND: THE PLACE

Ethanol production is growing. America is a bountiful country that has the ability to produce enough plant sources to meet an increasing demand for ethanol.

Corn use for ethanol more than doubled in just the 4 years between 2001 and 2005.

The majority of the ethanol plants are in the Midwest states of

- Iowa
- Illinois
- Minnesota
- Nebraska
- Kansas
- South Dakota
- Missouri

FAST FACTS

Three states account for 50% of the U.S. corn production.

- #1: Iowa
- #2: Illinois
- #3: Nebraska

In this geographic region, referred to as the Corn Belt, soils are deep, fertile, and rich in organic material and nitrogen. The land is relatively level. The warm nights, hot days, and well-distributed rainfall during the growing season make this area of the United States ideally suited for raising corn.

Ethanol plant growth

- | | | |
|---------|--------------------|---|
| • 2000: | 54 ethanol plants | 1.74 billion gallons of ethanol |
| • 2006: | 100 ethanol plants | 4.5 billion gallons of ethanol produced |
| • 2008: | 140 ethanol plants | 7 billion gallons of ethanol to be produced |

Ethanol is produced from field corn, which is fed to livestock, not the sweet corn that human beings eat. Importantly, ethanol production utilizes only the starch portion of the corn kernel, which is abundant and of low value. The remaining vitamins, minerals, protein and fiber are still able to be sold as high-value livestock feed.

BACKGROUND: THE TIME

1908 Henry Ford builds the Model T to run on ethanol, gas, or a combination

1917 & 1941 World War I & II increase need for fuel, and ethanol demand and production are driven up.

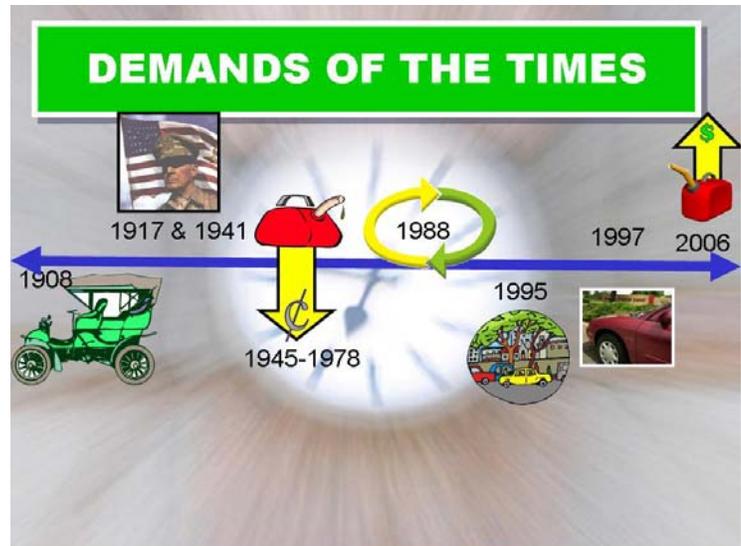
1945-1978 Reduced need for war materials and the low fuel prices drastically reduce ethanol production. From the late 1940s to the 1970s virtually no ethanol is available.

1988 Ethanol begins being added to gasoline to decrease pollution

1995 City with high smog levels are required to use gas with ethanol

1997 Car manufacturers begin producing cars that run on both gasoline and E85

2006 Gas prices high and unstable and desire for less dependence on foreign oil cause ethanol production to soar.



INSTRUCTIONAL PROCEDURE

1. On a map of the world mark where Americans get oil for fuel and where Americans obtain their source of corn for fuel.
2. Complete Activity 1.
3. Discuss the biofuels timeline.

ASSESSMENT

Have the student explain how it helps the earth to use renewable sources of energy. How will using renewable sources of energy affect you? Your children? Your grandchildren?

NAME _____

ACTIVITY 1 — GEOGRAPHY & FUEL

GEOGRAPHY AND FUEL

1. What are some of the limitations that geography imposes on access to oil for fuel?

-
-
-
-
-

2. What geographical characteristics allow Iowa, Illinois and Nebraska to grow more corn than Colorado or Utah?

-
-
-
-
-

3. How is the use of our land different today than in 1950's?

-
-
-
-
-



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ACTIVITY 2 — EXTENDING THE TIMELINE

THEORIZE

Extend the “Demands of the Time” timeline out for the next 50 years.

ANSWER

What do you expect to happen?

DISCUSS

Do you see the trends causing the current surge in ethanol production and usage to continue? Why or why not?



NATIONAL SOCIAL SCIENCE STANDARD

- Economics: Increases in productivity result from advances in technology and other sources

NATIONAL SCIENCE STANDARD

- Science: Transfer of energy

OBJECTIVES

The student will:

1. identify the type of energy used when burning biofuels.
2. understand that it takes energy to turn corn into fuel.
3. understand the methods used to provide a positive energy balance in biofuels production.
4. be able to chart the flow of energy from the sun to the end use.

BACKGROUND

Energy changes form. Biofuels use solar energy transformed during photosynthesis into chemical energy and released through burning in a combustible engine. Biofuels provide us with energy to fuel our cars.

Processing corn into biofuels also takes energy. Most ethanol is created through fermentation of the starchy parts of plants, primarily corn. The corn is finely ground and separated into its component parts of starch, corn germ, fiber and gluten. Microscopic yeast cells break down the starch and water, creating ethanol and carbon dioxide gas.



Planting, growing, harvesting, and processing the corn into ethanol all take energy.

Examples of the energy required are:

- Planting and harvesting require fuel to run the machinery.
- Growing requires fertilizers and chemicals to control the weeds and insects.
- Transporting the corn to processing plants require fuel.
- Processing the corn into ethanol requires electricity and heat.

FAST FACTS

Energy is defined as the ability to do work. That work can be divided into five main tasks:

- Give light
- Give heat
- Make things move
- Make things grow
- Make technology work

BACKGROUND, CONTINUED...

The question is: do we get more energy from the ethanol than it takes to produce it?



A 2004 study by the U.S. Department of Agriculture determined ethanol yields 34% more energy than is used to grow, harvest and process the grain. Improvements in technology allow more corn to be produced with less energy inputs.

The amount of corn that can be grown on fertile land increases all the time. Between 1995 and 2005 farmers increased the amount of corn grown per acre from 110 bushels to 130 bushels. By 2015 farmers will increase corn output to 180 per acre. The machinery does the same amount of work and uses the same amount of fuel as 10 years ago, but farmers gets a 75% increase in the amount of corn produced.

By using biotechnology to develop seeds that are drought resistant, crops can be grown in places that were previously unable to support crop growth. At the same time, these biotech seeds require fewer fertilizers and chemicals.

Fast growing native, nonfood crops that produce the same starch components necessary for ethanol will soon be an option. Native plants require less intensive farming practices and supplies; therefore, it takes less energy to produce them. Crops such as switchgrass and poplar trees are examples.

INSTRUCTIONAL PROCEDURE

1. Complete Activity 1.
2. Complete Activity 2.
3. Discuss the biofuels timeline.

ASSESSMENT

Have the students discuss the long-term impact of using renewable energy sources.

WORD POWER

acre *n.* A measurement of land. One acre is approximately the size of a football field.

bushel *n.* A unit of volume or capacity equal to 4 pecks

chemical energy *n.* Energy that results from a chemical reaction

energy *n.* The ability to do work.

native crops *n.* Crops that grow naturally in an area. For example, corn is native to North America..

peck *n.* A unit of volume used in dry measurement. A peck is equal to 8 quarts

NAME _____

ACTIVITY 1 — GO WITH THE FLOW

FLOW CHARTING

Chart the energy needed starting with the sun to run a car.



DISCUSSION

Is the flow of energy from sun to fuel similar to the energy flow needed to fuel the human body?

NAME _____

ACTIVITY 2 — ALTERNATIVES MATTER

THINK OUTSIDE THE OIL FIELD

Farmers are becoming more productive all the time.

Studies show that with the advances made in crop productivity that 34% more energy is obtained from ethanol than is required to produce it. Part of that is due to alternative crops that can be used in ethanol production.

1. Assign students to look up the alternative crops from the box at right and report to the class.



ALTERNATIVE CROPS

- Switchgrass
- Small woody plants
- Poplar trees
- Corn Stover (left over stalks after corn is removed from the plant)
- Willow trees

2. For each alternative crop, do the following:
- Describe the crop
 - Describe the conditions in which it can grow
 - Describe the effect of crop on the environment
 - Tell how much can be grown per acre
 - Tell how much time it takes to grow to maturity and be ready for harvest
 - Provide pictures of the energy source



GRADES 5 & 6 — WHAT'S DRIVING BIOFUELS?

NATIONAL SOCIAL SCIENCE STANDARD

- Roles of Incentives: Changes in incentives cause people to change their behavior in predictable ways.

OBJECTIVES

The student will identify the incentives driving ethanol production.

BACKGROUND

Americans have relied on fossil fuels as their primary engine fuel since the 1920s. Environmental concerns, decreasing supplies and rising costs are some of the incentives fueling the shift in Americans dependence and habit of using fossil fuels.

The United States is increasingly dependent on imported energy to meet our personal transportation and industrial needs, but two-thirds of the world's known oil reserves are located in the volatile Middle East.

The rising, unstable cost of using fossil fuels are two of its drawbacks. In contrast, using ethanol in the U.S. fuel marketplace helps lower gasoline prices by expanding gasoline supplies and reducing the need for importing oil from the Middle East.

Because it is made from plants, if ethanol is spilled, it is completely biodegradable; therefore, it leaves no harmful waste in our environment and would prevent the problems encountered from large oil spills in our oceans.

Ethanol contains 35% oxygen by weight and when combined with gasoline it acts as an oxygenate, meaning it puts oxygen in gasoline. The higher level of oxygen allows for the gasoline to burn more completely resulting in less smog and fewer breathing problems.

To retrieve fossil fuels, mining is necessary, which in turn has a negative impact on the landscape.

Biofuel has many important benefits. American farmers can produce it providing a significant contribution to the American economy. It creates high paying jobs, increases market opportunities for farmers, generates household income and tax revenue, and stimulates capitol investment. In 2005, the ethanol industry supported the creation of more than 153,725 jobs in all sectors of the U.S. economy, boosting U.S. household income by \$5.7 billion.

WORD POWER

biodegradable *adj.* Something that can be broken down naturally by bacteria.

capitol investment *n.* An amount of money used to start a business or large purchases to run a business.

economy *n.* The way a country runs it's industry, trade and finance.

oxygenate *v.* To treat, combine, or enrich with oxygen.

incentive *n.* Something that encourages you to make an effort.

import *v.* to bring into a place or country from elsewhere.

NAME _____

ACTIVITY 1 — BIOFUEL BENEFITS

POSSIBLE EFFECTS

For each statement write two possible effects related to biofuels.

1. The price of gas remains above \$3.00 per gallon.
2. The U.S. natural fuel sources are depleted.
3. A farmer's personal earnings increase because of increase need for corn.
4. Need to transport oil across oceans decrease.
5. The oxygen in biofuels allows it to burn more completely.
6. A rural community builds an ethanol plant.



NAME _____

ACTIVITY 2 — WRITING

OPINION / EDITORIAL WRITING

Which of the incentives covered would motivate you personally to support biofuels development and use?

Write a paragraph supporting your choice.

This paragraph should include a topic sentence, 3-4 concrete details to support the topic sentence, and a concluding sentence.

